Reserve personnel have been trained and authorized by the U.S. Fish and Wildlife Service to recover dead and injured manatees and other marine mammals. Reserve staff have participated in the recovery of over 70 injured and dead manatees during the past ten years, including such events as the 1996 red tide induced manatee mortality event.

Resource Management

The Reserve's stewardship activities were initiated in 1990 and a formal staffed program developed in 1993 to address the stewardship, restoration and land acquisition needs for the Reserve. Since that time, this program has worked effectively to maintain the ecological integrity of the Reserve to provide a stable environment for research and education consistent with the NERRS mission.

Key elements of the RBNERR resource protection strategy:

- Facilitating public acquisition of key lands associated with the Rookery Bay and Ten Thousand Islands ecosystems to help ensure long-term preservation of resources..
- Identifying essential habitats within RBNERR.
- Working in cooperation with federal and state agencies to protect listed species such as the West Indian manatee, American crocodile, Florida scrub jay and loggerhead sea turtle.
- Working with the regulatory and development community to address potential impacts associated with planned development projects within the watersheds of the Reserve.
- Designing and conducting restoration of disturbed wetlands, altered watershed inflows, and plant communities infested with invasive non-native plants.

Diversity Management

The Reserve's Resource Management Program is responsible for implementing science-based management to conserve natural biodiversity by recommending and implementing approved strategies to (1) protect the natural resources of the Reserve and it's watershed; (2) identify needed hydrologic and habitat restoration within the Reserve and its watershed; (3) restore natural conditions to the fullest extent possible using the best available techniques; and, (4) export information on management and restoration activities to environmental managers and decision makers. The primary goals are to protect and restore natural ecological functions within the areas managed by the Reserve through invasive species control, prescribed burn management and hydrologic restoration of wetlands and to assist in the recovery of endangered species through cooperative efforts with private landowners, and local, state and federal agencies and organizations. A primary function of the Resource Management program is to identify and pursue acquisition, management and restoration of natural resources at the watershed, community, habitat and site levels by coordinating with federal, state, local and private entities to affect watershed-scale restoration and conservation.

CORE OBJECTIVES

- Monitor nesting shorebird habitat and assist in protection by placing signs around seasonal shorebird nesting sites within the areas managed by the Reserve
- Work with the National Audubon Society to monitor and conserve natural scrub jay habitat based on a multispecies conservation strategy
- Develop and implement a prescribed burn rotational plan for each fire-dependent habitat within the area managed by the Reserve guided by a multispecies conservation strategy and GIS database of terrestrial habitats developed in conjunction with Research staff
- Develop and implement a Nuisance Animal Control Plan
- Implement the Reserve's Invasive Plant Control Plan
- Continue current levels of involvement with marine mammal stranding network, including monitoring of manatees and sea turtles. Promote expansion of the regional marine mammal stranding network to provide more complete regional coverage.
- Continue to monitor crocodile nest abundance and distribution.
- Implement recommendations of the Timber Management Assessment prepared by the Division of Forestry
- Work with landowners within the Reserve and its watershed on cooperative management strategies to protect native biodiversity (e.g. Keewaydin and Little Marco Islands invasive plant removal, Tarpon Bay public access).

Fire

Natural communities within RBNERR, including scrub, pine flatwoods, marshes and wet prairies, are dependent upon fire to maintain species composition and diversity. Lightning has been the main source of fire ignitions throughout the evolution of the South Florida landscape, although humans have

been influencing the fire regime for thousands of years. In the last hundred years increased human intervention in the form of hydrologic alterations, creation of artificial firebreaks (e.g. roads, canals), fire suppression, and intentional and accidental ignitions has severely disrupted the natural fire regime. Alteration of natural fire intervals is considered one of the major ecological impacts of humans on the South Florida ecosystem.

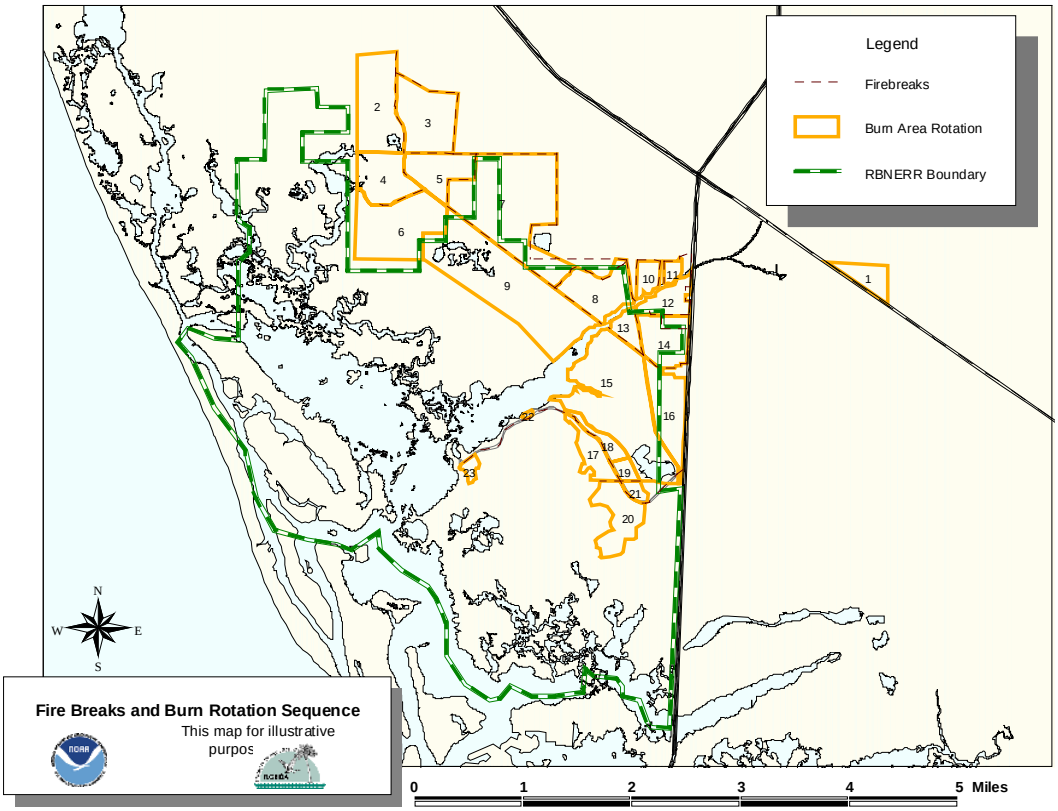
Controlled burns are now used extensively in fire-dependent habitat to eliminate potential fuel for arson and wildfires. Prescriptions are written for fires, so that burning occurs under selected, controlled conditions, while protecting life and property from damage.

Fire Research and Monitoring

There are 24 prescribed fire units within Rookery Bay NERR with locations shown on the fire map. These units are currently being rotated to complete hazard/fuel reduction prescribed fires and will be placed in long-term management rotations following the initial fuel reduction fires.

Typically, evaluation is conducted after the post-burn growing season to determine overstory mortality and herbaceous plant response. Shortly after individual burns or wildfires, Reserve staff conduct a walk through to see if cultural sites were exposed by the fire activity or whether there were readily observable impacts to listed species, water quality, or boundary fencing.

In addition to usual post-fire monitoring, more fundamental fire research is currently in progress. The primary goal of this study is to establish the baseline data, and begin experimental treatments and monitoring for a long-term study of season (summer, winter) and frequency of burning (3 to 5 years for pine flatwoods, 5 to 10 years for oak scrub) in selected fire-dependent Rookery Bay National Estuarine Research Reserve habitats (oak scrub, pine flatwood). Replicated experimental fires are to be conducted to examine variability among burning regimes in both fire characteristics, changes in plant and animal composition, diversity and relative abundance. Fixed plots will also be established



throughout the Reserve to monitor plant response to prescribed fire. The research and monitoring will provide detailed data on plant and animal responses to different burning regimes that will be considered along with public safety and other management concerns in refining the Reserve's prescribed fire program.

Wildfire Policy

Upon discovery, unplanned fires occurring on Reserve lands shall be assessed to determine fire behavior. DOF and Reserve staff shall conduct this assessment.

If weather conditions warrant and the fire is determined to be beneficial in meeting Reserve burn objectives, appropriate action will be taken to obtain a burn permit from DOF. Reserve staff would remain on-site and monitor or otherwise manipulate the fire behavior to meet burn objectives. Should the fire be determined to have a potentially detrimental impact on the natural community, produce unacceptable levels or behavior of smoke or have any potential for escape from the desired burn area, efforts toward suppression will be taken.

Any fire suppression activity should be taken using the least impactive method feasible. Use of backfiring, natural firebreaks, water/foam and "soft" firebreaks shall be preferred over plow lines or disking. In all cases, where the threat of injury or death, loss of property or liability to the State of Florida exists, immediate suppression by any means is acceptable. DOF personnel will be made aware of cultural site locations whenever possible to minimize degradation of the resource.

In areas where a naturally occurring lightning strike fire will present no harm to public safety or structures, provisions will be developed with the Florida Division of Forestry to allow these areas to naturally burn.

Fire Frequencies for Florida Natural Areas Inventory habitat classifications

Community (FNAI)	Primary Components	Fire Frequency
Scrub	Scrub oaks, rosemary and lichens	20-80 years
Xeric Hammock	Live oak, laurel oak, saw palmetto	26-100+ years
Beach Dune	Sea oats, mixed salt tolerant grasses and herbs	20-80 years
Coastal Strand	Saw palmetto, sea grape, cocoplum, yucca, cacti	20-80 years
Maritime Hammock	Mixed hardwoods, live oaks, stoppers, gumbo limbo, wild coffee	26-100+ years
Dry Prairie	Wire grass, saw palmetto, mixed grasses and herbs	1-7 years
Mesic Flatwoods	Slash pine, saw palmetto, gallberry, mixed grasses	3-7 years
Prairie Hammock	Live oak, cabbage palm	20-80 years
Scrubby Flatwoods	Slash pine, scrub oak, mixed grasses	8-25 years
Hydric Hammock	Water oak, cabbage palm, red maple, bay, hackberry, mixed hardwoods	26-100+ years
Wet Flatwoods	Slash pine, cabbage palm, mixed grasses and herbs	3-7 years
Wet Prairie	Maidencane, beakrush, spikerush, St. John's wort, mixed herbs	1-7 years
Floodplain Marsh	Maidencane, arrowhead, pickerelweed, buttonbush, mixed emergents	3-25 years
Floodplain Swamp	Cypress, pop ash	26-100+ years
Freshwater Tidal Swamp	Cypress, bay, cedar	26-100+ years
Slough	Pop ash, pond apple, water lily	8-100 years
Strand Swamp	Cypress, willow	8-100 years
Depression Marsh	Maidencane, fire flag, pickerelweed, and mixed emergents	3-25 years
Tidal Swamp	Black mangrove, buttonwood, red mangrove, white mangrove	100+ years

Part of the fire equipment at RBNERR, soon to be outfitted with water tanks

A crown fire in a pine flatwood with a large population of palms about three days after the burn

The burnt pine crowns about three days following a fire

Less than two weeks after a crown fire, a small flower blooms in the ashes.

Two to three weeks after a severe fire, vines have grown 5 feet up the trunks.

Two to three weeks after a crown fire, saw palmettos have begun to resprout.

Four to six weeks after a severe fire, saw palmettos are almost completely covered with fans, ground covers are filling in the bare soil and pine litter is beginning to build up. In about three months, the ground will be completely covered with knee-high understory.

Habitat Management

A multi-species environment relations model has been implemented to attain the goal of preserving biological diversity of Rookery Bay National Estuarine Research Reserve (RBNERR). The traditional approach to fauna and flora management focussed upon species. For practical reasons, there are simply too many important species in the Reserve to handle on a species-by-species approach.

Larger-scale approaches, at the level of habitats and ecosystems, are the only way to conserve existing biodiversity. A multi-species - environment relations model can be used to pose new questions about the roles and relationships of species in habitats and how managers might provide for species' ecological functions through ecosystem management.

Ecosystems are defined by their structure and function. The model uses a relational database to keep track of fauna and flora species along with the functions and structure they contribute to and tolerate and their range of distributions. In this model, structure is labeled as key environmental correlates (KEC) and function is key ecological functions (KEF). Key environmental correlates are abiotic or biotic conditions of a species' environment that proximately influence the fitness of individuals and viability of populations. Key ecological function refers to a species' main ecological roles that influence diversity, productivity, or sustainability of ecosystems. A given KEF can be shared by many species, and a given species can have several KEFs.

KEC Table: A sample from the hierarchic classification of key environmental correlates for the fauna and flora species of RBNERR[H].

1. Habitat
    1.1 Cover type
        1.1.1 Terrestrial and Freshwater
            1.1.1.1 Scrub
            1.1.1.2 Pine Scrub
            1.1.1.3 Cabbage Palm-Oak Hammock
            1.1.1.4 Pine Flatwood
            1.1.1.5 Tropical Hardwood Hammock
            1.1.1.6 Cypress Savanna/Prairie
            1.1.1.7 Cypress Strand
            1.1.1.8 Freshwater Marsh, Flatwood
            1.1.1.9 Freshwater Marsh, Wet Prairie
            1.1.1.10 Beach/Dune
            1.1.1.11 Coastal Strand
            1.1.1.12 Open Water
        1.1.2 Estuarine and Saltwater
            1.1.2.1 Saltmarsh

KEF Table: A sample from the hierarchic classification of key ecological functions for the fauna and flora species of RBNERR[H].

1. Trophic relationship
    1.1 Primary producer
        1.1.1 Autotrophe
        1.1.2 Hemiparasite
    1.2 Heterotrophic consumer
        1.2.1 Primary consumer
            1.2.1.1 Foliovore
            1.2.1.2 Spermivore
            1.2.1.3 Browser
            1.2.1.4 Grazer
            1.2.1.5 Frugivore
            1.2.1.6 Sap feeder
            1.2.1.7 Root feeder
            1.2.1.8 Sequestration of plant metabolites
        1.2.2 Secondary consumer
            1.2.2.1 Consumer or predator of invertebrates
            1.2.2.2 Consumer or predator of vertebrates
        1.2.3 Omnivore

Invasives/Non-natives

Much of southwest Florida has been invaded by invasive plant and animal species. These species displace native vegetation and turn once biologically diverse systems into near monocultures with minimal diversity. The Invasive Plant Control Plan was developed to focus invasive plant control efforts at the Reserve: identifying the invasive species and areas of likely infestation; presenting methods for controlling these species, including physical, chemical and biological; targeting priority sites; and tracking reinfestation rates and levels of maintenance required for habitat restoration.

Rookery Bay NERR has been involved in habitat restoration through invasive plant control for more than ten years. Control has been accomplished through staff and volunteer efforts, as well as contractual services, using chemical, mechanical and hand removal, depending upon the site conditions. These activities are funded through many different sources, including in-house management funds, grants, mitigation, and private landowners. The balancing of parcels for priority based on funding options generally begins with projects that are adjacent to existing or on-going control sites to maximize effectiveness by decreasing the adjacent invasive plant seed source and concentrating efforts.

Invasive plants have been assigned by the Exotic Pest Plant Council (EPPC) into three categories, as determined by their invasive characteristics and potential.

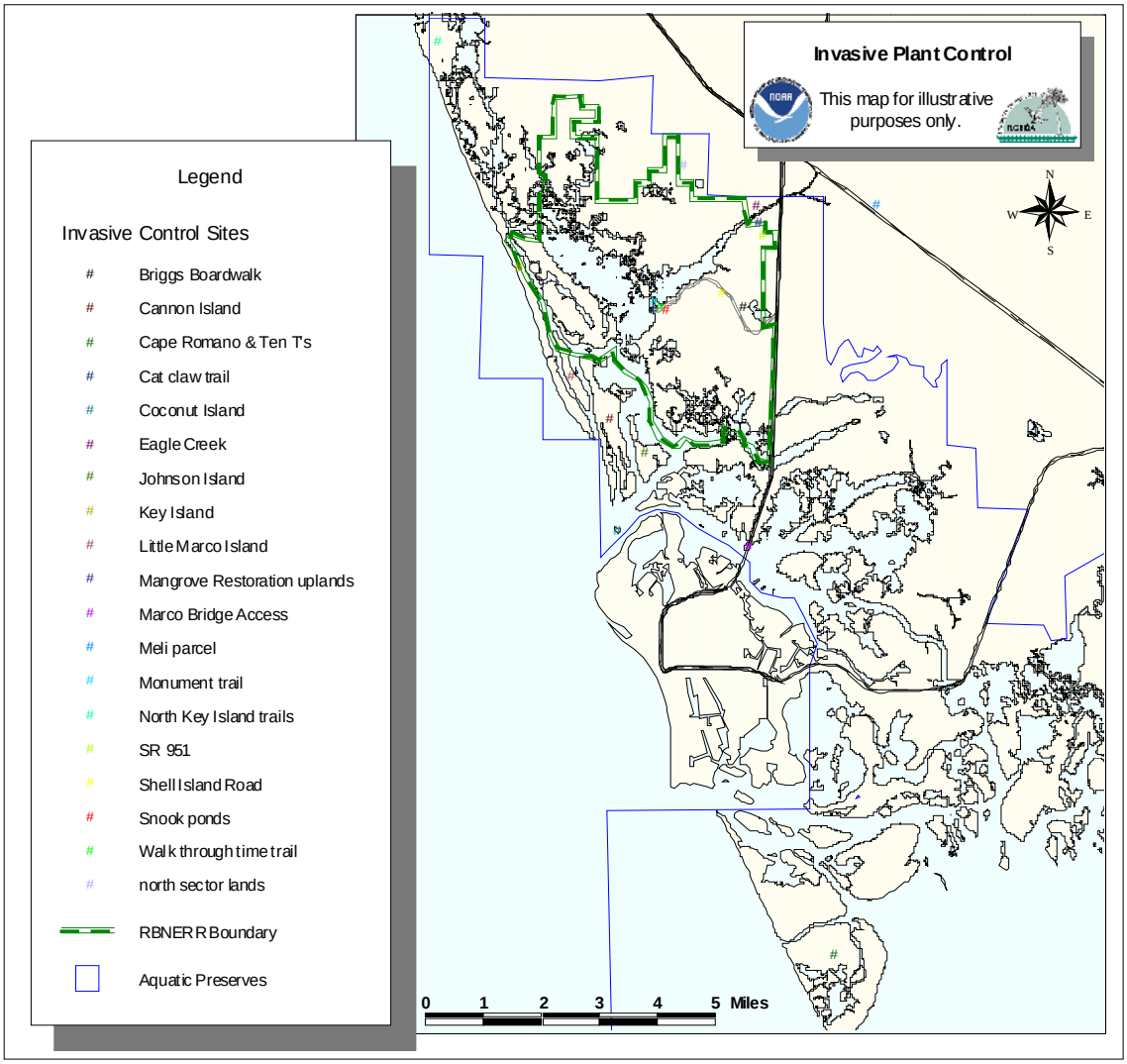
Native - a species already occurring in Florida at the time of European contact (1500) (Stevenson, 1993).

Non-native – a non-indigenous species, or one introduced into the state, either purposefully or accidentally; it then escaped into the wild in Florida where it reproduces either sexually or asexually.

Invasive - is a variable condition defined by the category to which the species is assigned.

Category I - Species that are invading and disrupting native plant communities in Florida. *This definition does not rely on the economic severity or geographic range of the problem, but on documented ecological damage caused.*

Category II - Species that have shown a potential to disrupt native plant communities. *These species may become ranked as Category I, but have not yet demonstrated disruption of natural Florida communities.*



MANAGEMENT STRATEGIES

There are many methods that can be used to control invasive, exotic plants, including chemical, physical and biological methods. In this section, each control method is discussed, with references to specific methods used at RBNERR.

CHEMICAL CONTROL METHODS

The use of herbicides is imperative in controlling invasive plant species. Defined below are the methods currently used for applying herbicides at the Reserve.

Foliar	Herbicides are pre-mixed with a diluent and sprayed onto the foliage of the plant so that the leaves are 'sprayed-to-wet', which means applying only enough solution to begin running off the leaf surface.
Cut Stump	Immediately after cutting the stem or trunk near ground level, an herbicide is applied to the stump.
Basal Bark	Herbicides are applied to the stem or trunk of the plant in a wide band near the base. The chemical is absorbed and translocated throughout the plant.

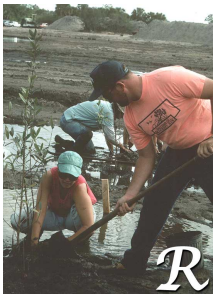
Herbicides currently used at the reserve include Arsenal, Brush-B-Gon, Garlon 3A, Garlon 4, Rodeo, Round-up, and Scythe. Oils, surfactants, and dyes are used to enhance the activity of the herbicide. Oils and dyes in use at RBNERR include Bas-Oil Red Dye, Cidekick II, Improved JLB Oil Plus, Kammo Penetrant, and Terramark Blue Dye.

Non-Target Damage

Some chemicals, including some used at the Reserve, damage non-target vegetation. Specifically, Arsenal translocates through the soil and causes leaf deformation (known as rosetting) in certain plants. Mangrove species, particularly green buttonwoods, are especially sensitive to the cut stump applications of this chemical. The recommended label strength for cut stump application is 50%. However, at the Reserve, Arsenal is used at a concentration of 10%. Even at this lower concentration, Arsenal causes non-target damage to adjacent buttonwoods. Other land managers have commented on non-target damage, specifically South Florida slash pine, from cut stump application of Garlon. However, these effects have not been documented at the Reserve.

PHYSICAL CONTROL METHODS

Mechanical control of invasive plants is used in some areas. In high density infestations, bulldozers, front end loaders, root rakes and other specialized heavy equipment can be used. Tools,



Restoration

Habitat and hydrologic restoration efforts at Rookery Bay encompass a variety of activities, including control of invasive plants and, when applicable, planting of native plants, removal of abandoned roadbeds and filling of associated canals and ditches, **GeoWebbing** existing access roads, construction and installation of stormwater management systems and control structures, installation of culverts, and re-contouring of filled and/or disturbed areas based on historic site composition. Both type of funding and timing of funds play a role in prioritizing projects. Priority based on funding options generally begins with projects that have altered hydrology where restoration will have an expansive impact and with projects that are strictly invasive plant control given lower priority.

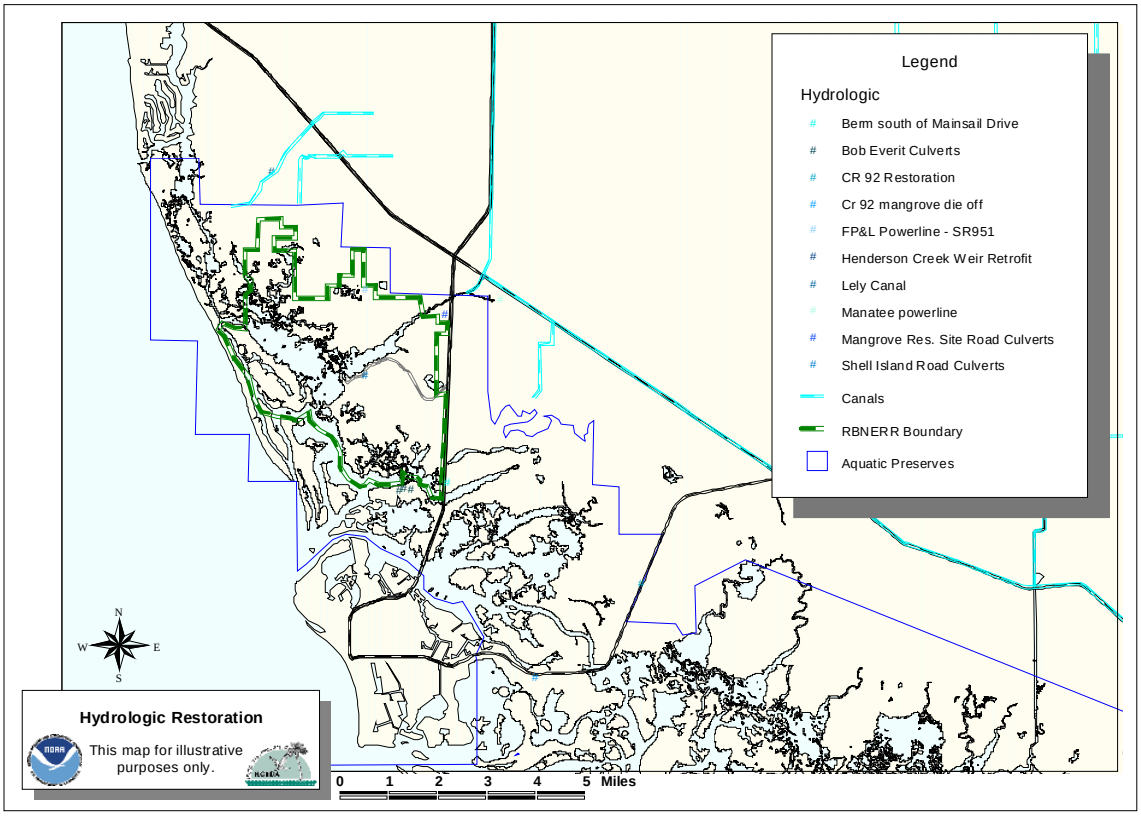
GeoWebbing involves taking the roadbed down below adjacent grade, layering filter fabric and 4" plastic egg crate material, then backfilling the egg crate material with septic rock. This stabilizes the road base for vehicular traffic during the rainy season, while allowing surfacewater to sheetflow horizontally over and percolate vertically through the roadbed.

Some projects focus on partnering and supporting efforts by other agencies within the watershed. While Rookery Bay may not be the lead agency, there is a vested interest in the restoration and Rookery Bay may contribute funds through grants, assisting with mitigation or through in-kind services. The list of potential restoration projects for the Reserve is extensive, and while challenging, it is also realistic. Development is occurring at an unprecedented rate. This development provides opportunity for numerous project specific mitigation efforts. Additionally, Rookery Bay has successfully received 10 grants in the past 5 years, totaling more than $5.5 million, toward acquisition and restoration efforts.

Land Acquisition

Rookery Bay's Conservation and Recreation Lands (CARL) Project, supplemented by funds from USFWS and NOAA grants, has been successful in acquiring 97% of the project which includes lands critical to long-term protection of the natural and cultural resources. An estimated $50 million has been expended to acquire primary, secondary and tertiary barrier islands, as well as inland parcels that buffer the Reserve, connect hydrology and habitats, and protect water quality entering the estuaries. In addition to the Rookery Bay CARL Project, four acquisition projects have been funded through the US Fish and Wildlife Service's National Coastal Wetlands Program, and are contiguous to the Reserve's boundaries: (1) Keewaydin Island Acquisition - acquisition of critical primary barrier island habitat; (2) Cape Romano – acquisition of a primary barrier island complex; (3) Henderson Creek – acquisition of critical parcels that connect the watershed to the estuary; and, (4) the Ten Thousand Islands – acquisition of remaining outparcels within this extensive network of mangrove islands.

Current acquisition efforts focus on remaining inholdings (surrounded by state owned and managed



lands), outparcels (adjacent to state owned and managed lands) and connector parcels (connecting critical hydrologic flowways and habitat corridors). These lands are primarily upland sites that buffer existing Reserve protected areas. Some of these sites are in pristine condition and some will require restoration. The disturbed sites targeted for acquisition include areas within or adjacent to flowways within the watershed that need to be protected, lands that serve as wildlife and habitat corridors, areas that can function as stormwater retention sites for water quality protection and parcels that are buffers to pristine Reserve lands.